DRAFT

Redd Dewatering and Juvenile Steelhead and Spring-Run Salmon Stranding in the Lower Feather River, 2000-2001

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INTRODUCTION

In March 2000 the National Marine Fisheries Service (NMFS) issued a Biological Opinion (NMFS 2000) for the California State Water Project (SWP), which required the Department of Water Resources (DWR) to develop a monitoring program to determine the extent of juvenile steelhead and spring-run salmon stranding and redd dewatering resulting from SWP operations on the Feather River. In response, DWR proposed a study plan consisting of two major components: aerial and ground surveys to locate spawning riffles and potential stranding areas and biological observations to estimate the incidence of juvenile stranding and redd dewatering. Results from the monitoring program are to serve as a basis for establishing long-term ramping rate criteria to minimize the potential for stranding juvenile salmonids.

The objectives for the first year of this study were: 1) to survey spawning sites to determine the number of redds dewatered by reductions in flow; 2) to identify potential ponding areas using historical data, aerial photos and ground surveys; 3) to sample established ponds to determine the relative abundance of stranded salmonids; and 4) to determine the biological significance of stranding / redd dewatering losses to the existing population of salmonids in the river. The following is a preliminary report summarizing program activities from January to May 2001.

METHODS

Study Area

The Feather River drainage is located within the Central Valley of California, draining an extensive area of the western slope of the Sierra Nevada (Figure 1). The Feather River is of low gradient from the Oroville-Thermalito Complex downstream to the confluence with the Sacramento River. Oroville Dam and Thermalito Diversion Dam regulate flow into the lower Feather River below the reservoir. Under normal operations, the majority of the Feather River flow is diverted at Thermalito Diversion Dam into the Power Canal and Thermalito Forebay. The remainder of the flow, typically 600-cfs, flows through the historical river channel, the "low flow channel." Water released from the Forebay is used to generate power before discharge into Thermalito Afterbay. Excluding local diversions and occasional pumpback operations, the water is returned to the Feather River through Thermalito Afterbay Outlet, then flows southward through the valley to the confluence with the Sacramento River at Verona.

DWR has been conducting fisheries research on the upper 25 miles of the lower Feather River for nearly five years. This portion of the river consists of the low flow channel (LFC), which extends from the Fish Barrier Dam to the

Thermalito Afterbay Outlet, and the high flow channel (HFC), which extends from the Outlet to Honcut Creek (Figure 2). The reaches differ in channel morphology, flow characteristics and salmonid abundance. Most salmon spawning and juvenile rearing is in the LFC (Sommer et al. 2001).

Since flows in the LFC remain constant year-round, stranding or redd dewatering would occur mainly during flood events. Another exception could occur during summer, if flows were manipulated to meet temperature criteria promulgated by NMFS.

The HFC is more complex and flow is more variable, which would increase the risk of redd dewatering and juvenile stranding. Redd dewatering is not expected because, to date, there is no evidence that steelhead or spring-run salmon spawn in the HFC. However, a significant amount of rearing occurs, so juvenile stranding is possible. Thus, field efforts were concentrated in the HFC.

Redd Dewatering

During the salmon and steelhead spawning season, major spawning riffles in the HFC were visited after each reduction in flow. Measurements included river mile, flow and the number of exposed redds. Redds were considered dewatered if the water surface elevation had dropped below bed elevation.

The incidence of redd dewatering was compared with the estimated number of salmon redds in the study area in 2000 to determine redd losses as a proportion of the total in the river.

Juvenile Stranding

Historical aerial photos and previous observations were used to identify areas where stranding might occur. Subsequent to each flow reduction, ground surveys were conducted in these areas to locate isolated ponds. Measurements included river mile, flow and surface area. The surface area for small ponds was calculated from the average length and width. The area of large ponds was estimated from aerial photos of known scale.

A sub-set of ponds was sampled by beach seine. Fish were identified, measured (up to 20 individuals for non-salmonids) and enumerated. The fork length (mm) of up to100 salmon and steelhead were measured and the remainder enumerated. The proportion of spring run sized fish in the sub-sample was used to estimate the number of spring run sized salmon in the total catch. Run identification was based on a daily length table (Greene 1992) for Central Valley chinook salmon.

Fish density (number of fish per area swept) was used to estimate species abundance for the entire pond. Mean fish density across all ponds was computed and multiplied by the total area of ponds to estimate the number of salmon and steelhead stranded in the study area.

The incidence of stranding was compared with emigration estimates from rotary screw trap operations to determine the stranding losses relative to the population of juvenile spring-run salmon in the river.

RESULTS

There were thirteen flow reductions on the Feather River from January to May 2001. In the HFC, flows ranged between 1000 and 3000 cfs. As expected, the LFC remained at 600 cfs the entire period.

A total of 23 dewatered salmon redds were identified (Table 1). The majority of exposed redds resulted from a decrease in flow in mid January (2050 to 1750 cfs). All dewatered redds were in the HFC.

Review of existing data, including aerial photos from 1998 and 1999, revealed 19 areas susceptible to stranding (flows between 1,000 and 8,000 cfs) from the Thermalito Afterbay Outlet to Honcut Creek. Ground surveys, from January to May 2001, confirmed 12 of these areas as subject to isolation. Estimated surface area and flow at which these areas isolate from the main river are provided in Table 2. The total estimated pond area of the HFC at the lowest flow was 40,370 m^2 (April 8, 2001).

Juvenile fall-run salmon, pikeminnow and hardhead were the most abundant species sampled (Table 3). Spring-run salmon were observed in three of the nine sampled ponds, while steelhead were only collected in one pond. Estimates of salmonid abundance in each sampled pond are in Table 4. The average density in beach seine samples was 0.07 fish / m2 for spring-run salmon and 0.001 fish /m2 for steelhead. Based on the total pond area, an estimated 2,500 spring run sized salmon and 40 steelhead were stranded from January to May 2001.

DISCUSSION

Twenty-three salmon redds were dewatered as a result of flow reductions, but it is impossible to know if the redds were from spring-run or fall-run salmon. To put losses due to dewatering in the context of the total population, we can use the escapement estimate for the Feather River. The 2000 carcass survey estimated the fall run at 117,000 salmon. An estimated 40% of those, or 46,000 fish, were female carcasses without eggs, and were considered to have spawned. On the conservative assumption that each female spawned only once, a loss of 23 redds is 0.05% of the total. This number appears insignificant in its impact on salmon egg production in the Feather River.

The impact of stranding on chinook salmon also appears insignificant when compared to the number of emigrants from the Feather River (43 million in 2001). Furthermore, it is likely that a large proportion of stranded salmonids were rescued by subsequent increases in flow. With additional research, periodic flushing flows may prove a viable solution to reduce the impacts of stranding on juvenile salmon.

Existing low water levels in Lake Oroville, coupled with a dry water year, reduced the magnitude of flow fluctuations in the HFC. This, in turn, may have reduced the incidence of stranding of juvenile spring-run and steelhead by restricting the river to a small proportion of the channel and a narrow range of flows. One season of study has not been sufficient to determine any patterns in stranding, whether biological, geomorphological, or behavioral.

Future goals for this project include: (1) measurements at higher flows; (2) a better definition of the relationship between pond formation and river hydrology; (3) measurement of biological characteristics of stranded salmonids, such as growth and survival and (4) assessing the ability of stranded salmonids to escape ponded areas once the pond reconnects with the main channel.

REFERENCES

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